WRESTLING WITH HIGH STORM TIDES
AT
THE HULL WATER POLLUTION CONTROL FACILITY

Frank J. Cavaleri, Area Manager
Professional Services Group

Norman A. Rogers, Manager
Hull Permanent Sewer Commission

Raymond T. Cranmer, Plant Manager
Professional Services Group

Massachusetts Water Pollution Control Association
March 20, 1996

WRESTLING WITH HIGH STORM TIDES AT THE HULL WATER POLLUTION CONTROL FACILITY

BY FRANK J. CAVALERI*, NORMAN A. ROGERS**
RAYMOND T. CRANMER***

[PRESENTED AT WINTER 1995 MEETING]

INTRODUCTION

Hull is an oceanside town located about 20 miles south of Boston, MA. It is heavily populated with strong recreational use of both beaches and harbors. The Hull Wastewater Treatment Plant, located at the intersection of Nantasket Avenue and Spring Street, is designed to treat 3.07 million gallons per day (mgd), with a peak design flow of 7.8 mgd through design year 1998.

The facility provides secondary treatment using conventional activated sludge followed by chlorination and discharge through an ocean outfall. According to the most recent FEMA flood plain mapping, the facility rests in a designated flood zone.

ARRANGEMENT OF FACILITIES

The WPCF is near the north end of Hull and is bounded on two sides by water. The largest aboveground structure on the site is the Control Building. This structure is about 129 feet long by 49 feet wide and contains two levels below ground, one at ground level, and a second story. Most of the personnel-related activities are performed in this structure.

In addition to housing facilities for pretreatment and pumping of influent wastewater and solids processing, the building is equipped with a maintenance shop, three rest rooms (one with locker and shower facilities), several administrative offices, a lunch room, and a laboratory. Other major structures on the plant site include two primary clarifiers with an underground sludge pumping station, a chlorine contact tank, two covered gravity sludge thickener basins, two below ground sludge holding tanks, a below ground septic sewage holding tank, two secondary clarifiers, an underground RAS/WAS pumping station and an underground effluent pumping station.

Raw wastewater from the sewage collection system enters the Control Building at a level about 17 feet below ground level where it is processed through the pretreatment facilities prior to being pumped to the primary clarifiers. The wastewater flows by gravity through the aeration tanks and secondary clarifiers to the effluent pumping station wetwell where it is then pumped to the chlorine contact

*Area Manager, Metcalf & Eddy Services; **Manager, Hull Permanent Sewer Commission; ***Plant Manager Metcalf & Eddy Services.

tank and then flows by gravity to the Atlantic Ocean. The facility was originally designed with gravity thickeners, vacuum filters, and a multiple hearth incinerator. The gravity thickeners are still used, the vacuum filters have been removed and a mechanical thickener installed, and the thickened sludge is pumped into tanker tracks and disposed of by NETCOs. The on-site incinerator has never been operated and has been abandoned for many years. A simplified process diagram is shown in Figure 1.

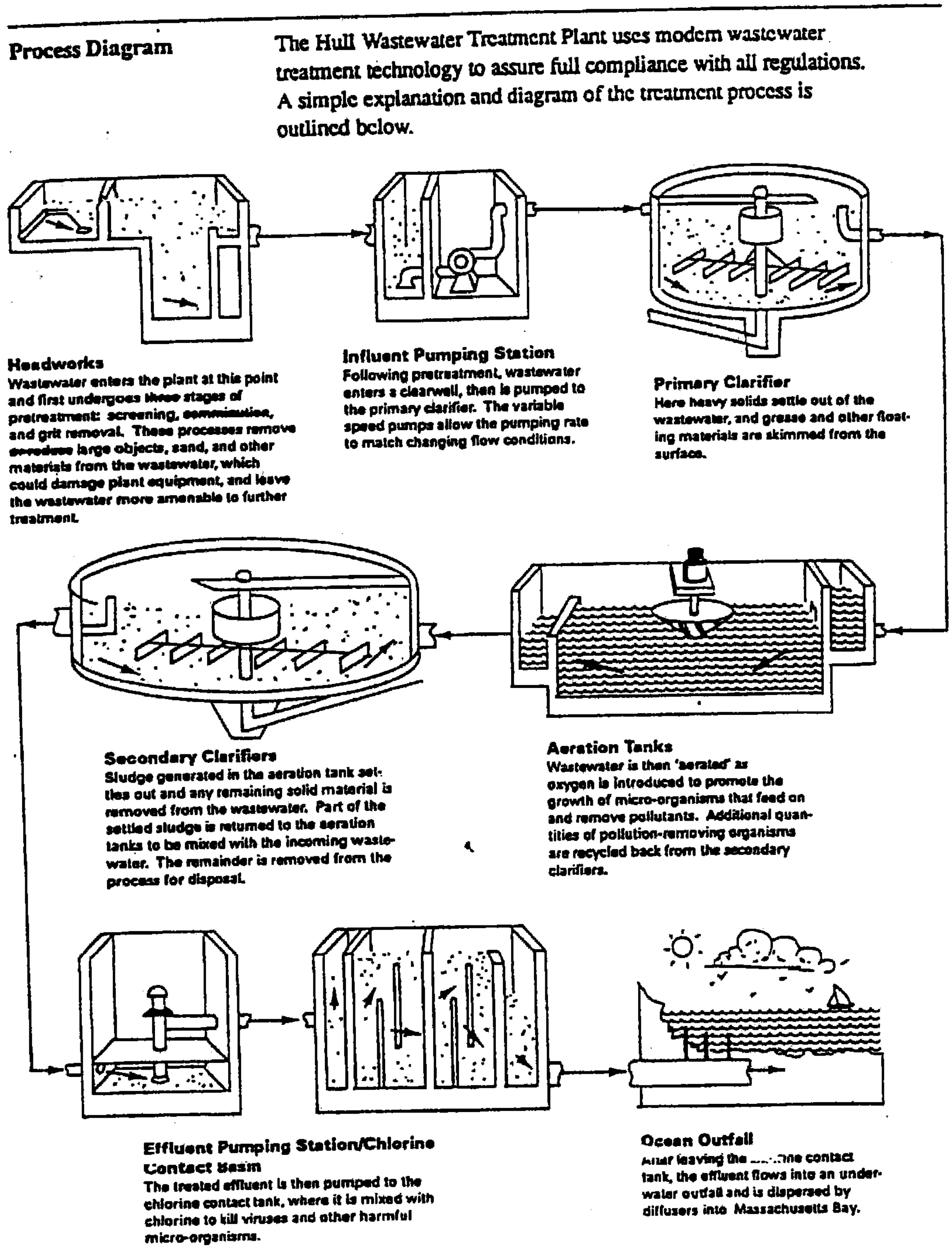

Figure 1. PROCESS DIAGRAM

COLLECTION SYSTEM

Gravity Sewers

Prior to 1978, 14 miles of combined sewers existed. These combined sewers were separated during Phase I and II construction, which was completed in the early 1980s. Phase I and II construction included the following areas:

The main interceptor sewer which is about 4 miles long (1 mile 30"/3 miles 36"). Other areas connected to the sewage system at this time included Strawberry Hill, Kenberma (Bayside), Sunset Point, and Harborview adding about 13.5 miles of sewer. Phase III construction started during the 1980s and continued into the early 1990s. Phase III construction included the following areas: The Kenberma Park area added 4.46 miles of sewer and the Alphabet Streets area added 7.30 miles. Total sewers in the Town of Hull are - 43.26 Miles.

A siphon at Nantasket Ave. & Warren Street was constructed after the Storm of '78 to allow for the placement of a 48" Drainage Culvert under at Nantasket Ave. at the location of the 36" interceptor. The collection system connects about 4,000 residential and business units to the treatment plant, and has about every type of pipe ever made including: brick (700 ft. 18" x 24" oval), VC, AC, PVC and who knows what else. Construction of the Village sewers can be documented back to the 1860s.

Pumping Stations

Name	Location	Design Capacity	Force Main Size/Length
L.S. "A"	Valley Beach Rd.	150 GPM	4" - 840 ft.
P.S. #1	Atlantic Ave.	450 GPM	8" - 2,050 ft.
P.S. #3	Geo. Wash. Blvd.	1700 GPM	14" - 4,625 ft.
P.S. #4	Marginal Rd.	800 GPM	8" - 1,000 ft.
P.S. #5	Draper Ave.	1600 GPM	14" - 530 ft.
P.S. #6	"L" St. Playground	800 GPM	6" - 60 ft.
P.S. #9	Main St. - High School	650 GPM	14" - 5,030 ft.
Total Length of Seven Force Mains			13,835 ft.

The collection system, pump stations, and the treatment plant are shown in Figure 2. The location of the treatment plant makes it extremely vulnerable to "Northeaster" storms.

CONTRACT OPERATIONS

In 1987, the Town of Hull, Permanent Sewer Commission, having dealt with years of extensive problems at the wastewater facilities and based on a recommendation from their consultant engineer, Tighe and Bond, decided to pursue contract operations of their WPCF. In January 1988, Metcalf & Eddy Services began a 5-1/2 year contract for facility operations, after successfully winning the bid competition.

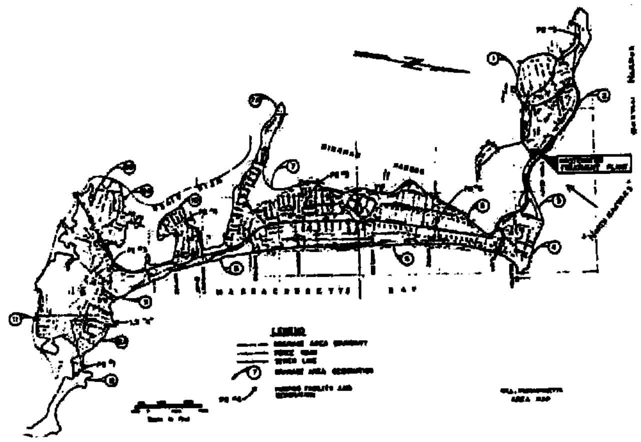

Figure 2.

In May 1993, Metcalf & Eddy Services (M&E) successfully rebid for the operation of the Hull Facility. This new contract was for 10 years and included an expanded scope of services, especially in the areas plant repairs and maintenance and collection system O&M.

The partnership between the Town of Hull and M&E Services has been tested and strengthened through the series of storms/floods which occurred at the facility over the years. The commitment of M&E Services to provide quality operations and maintenance of the Hull Facility, especially during severely adverse storm/flood conditions, was a major reason why they were successful in winning the 10 year contract in 1993.

HISTORY (PRE M&E'S INVOLVEMENT)

The Hull WPCF is extremely susceptible to flooding, and has had a long history of flood events. This is due to the arrangement of the buildings and equipment in the facility (i.e., below sea level) and to the coastal location (i.e., significant coastal flooding during storms). After the blizzard of 1978 (when the plant was totally flooded with the ocean level about reportedly 1.5 feet above the ground level operating floor), concrete walls were constructed in front of each ventilation grate and gasketed steel doors were placed in front of all building entrances. These concrete walls and steel doors were installed to reduce flood damage to the buildings from outside flood waters.

After the plant became operational in 1980, additional flooding events occurred at the plant due to excessively high plant influent sewage flows. A 1983 Black & Veatch (B&V) Report overviewed these flooding events and recommended some system improvements (see Appendix A). Although not discussed in the B&V Report, in 1984 influent and effluent hydraulic gate systems were installed to eliminate or reduce the potential of in plant flooding due to high sewage flows (see Appendix B). The 1983 B&V Report also recommended a plant by-pass, but it was never installed.

M&E SERVICES' STORM/FLOOD EXPERIENCE

Since M&E Services took over operation of the Hull WPCF in January of 1988, we have experienced three major storm/flood events as described in the next paragraphs.

August 1989 Rain Storm

The first major storm/flood event occurred when high influent sewage flow was caused by a rain event of 4+ inches in August 1989. At that time, a failure of an effluent pump room gate occurred causing the gate to remain in the open position. With the gate open, the pump room could not be protected from flooding. At the peak period of the storm, one of the effluent pumps experienced an electrical problem which caused a shut down of all the effluent pumps. Only quick reaction by plant maintenance staff (who manually closed two outside gates) kept the effluent pump room flooding, and damage, to a minimum.

Due to the partial flooding of the effluent pump room, several portable pumps were brought to the site to maintain flow through the plant. These portable pumps continued in service to process effluent from the final clarifiers until the effluent pump room was pumped out and repairs were undertaken. Flood damage to the two operational effluent pumps was minimal and they were placed back in service within one day. In addition, a broken hydraulic drive unit was replaced with a new more efficient Variable Frequency Drive (VFD) unit. Plans were made to install additional VFD drives on the other influent and effluent pumps as capital funding became available.

During this storm the plant experienced several closures of the hydraulic gates due to high levels in the influent wet well, power outages, and high effluent wet well levels. The influent gate was shut for several hours and the interceptor provided storage for the incoming sewage without causing homes to have sewer backups. The influent gate had to be manually throttled to restrict the flow entering the plant to the limits that could be pumped by the influent pumps. The stuck effluent wet well hydraulic gate was repaired in the days after the storm. This involved shutting off the plant effluent pumps for a few hours, and entering the wet well pits and manually freeing up the jammed hydraulically operated sluice gates.

October 1991 - "No-Name" Storm

In October 1991, the "no-name storm" brought high influent sewage flows along with outside flooding (about 1.5 feet above ground level). Luckily, there was minimal rainfall during this storm, otherwise the high flows and flooding would have been much worse. The peak sewage flow coming into the plant was about 10 MGD. During this storm, one of the effluent pumps broke down and another failure of a hydraulic gate occurred. Due to the broken-down pump, the hydraulic gate failure and the high flows, portable pumping equipment was again used to assist with pumping the effluent flow. The portable pump installed in the effluent pump room was a submersible pump and provided an additional advantage because it could function even if the effluent pump room flooded. After this storm, the effluent pumps were evaluated and reviewed to determine the best long-term, cost effective replacement. Recommendations were made to upgrade the existing effluent pumps with new larger heavier duty sewage pumps at an installed cost of about $20,000 each. Due to the high cost of replacement, and because 80 percent of the 3-month rental fee for the temporary pump could be used towards the purchase of a permanent unit, it was decided to install a submersible pump.

December 1992 Storm

In December 1992, a third storm/flood event occurred at the plant. This storm combined excessively high tides with over 5 inches of rain which caused excessive flooding and high flows. The details of this event are discussed below.

Beginning December 11th, the night the storm was predicted to begin, M&E personally began staffing the facility 24 hours per day to monitor pump stations and provide flow diversion (with off-line tankage) as necessary to minimize solids loss from the activated sludge process. Staff was also prepared to manually operate the automatic hydraulic gate system.

The first tide which affected the plant came at 1:00 p.m., Friday the 11th. Flow at this time was up to 5 MGD with flow spikes to 7 MGD, as the second effluent pump cycled.

At 2:15 p.m. flow was diverted to off-line aeration tank #4 which took less than one hour to fill. Recorded flow at this time was between 5 to 6 MGD.

By 3:00 a.m. on December 12th, flow was steady at 6.8 MGD. At 7:00 a.m. flow was diverted to our remaining spare tankage (aeration tanks No. 1 & No. 3). We continued to pump the flow through the plant until 10:00 a.m. on December 12th, when we had a power problem on one effluent pump. The problem was caused by an electrical short due to flooded electrical manholes. To reduce the possibility of another power problem all power to plant equipment, with the exception of the influent and effluent pumps and plant water pumps, was disconnected. Power was then restored to the off-line effluent pumps. At this point, flow moved through the plant with settling and chlorination treatment. Chlorine was shutoff to the effluent at 11:00 a.m. on December 12th because safe access to the chlorine room is not possible when the plant grounds are flooded. We called the DEP emergency number at around 11:00 a.m. to inform them of the plant status. Return flow and clarifier drives were shutoff at noon on December 12th. With facility grounds flooded, water flooded out the gravity thickeners.

Shortly after noon on the 12th, the effects of the second high tide became evident with the flow spikes exceeding 8 MGD. This high flow exceeded the capacity of the effluent pumps and caused the float gate to automatically close. Staff reopened the gates and coordinated manual gate operation to avoid further closures thereby processing the maximum flow possible. By 3:00 p.m. on December 12th, plant flow exceeded 8 MGD with four influent pumps running and three effluent pumps running.

Between the hours of 2:00 and 6:00 p.m. on the 12th, we received several calls from residents with flooded basements and backed-up sewers. Operators were dispatched to check the pumping stations near the affected areas. All pumping stations were found to be operating properly.

The main interceptor levels were then checked in the affected areas and the levels were found to be extremely high. At 6:00 p.m., operators checked the main interceptor levels again and found them to be 3 feet below street level, lower than 2 hours earlier. Plant flow at this time was off the chart recorder i.e., >8 MGD. At 10:00 p.m., we were contacted by Brendon Kelly of the DEP who was calling back to find out the plant status.

Flow continued in excess of 8 MGD from 6:00 p.m. on December 12th to 11:00 p.m. on December 13th. On December 13th, we installed two 6-inch portable submersible pumps and our 4-inch portable trash pump to help with the effluent flow. There was a slight drop in flow to 7.6 MGD from 12:00 midnight to 2:30 a.m., this drop in flow was used to process some of the backed up flow from spare tankage out of the plant. The portable pumps were set up to pump from secondary clarifier #2 to the contact tank. Automatic pump cycling as a result of reduced flows was not experienced until 3:00 a.m. on December 14th.

At 7:00 a.m. on December 14th, we began to restore the plant process by reintroducing chlorine to the contact chamber. A damaged clarifier drive motor, which had been flooded, was removed by maintenance for repair. Return sludge was started to the #2 and #4 aeration tanks without the benefit of the #2 secondary clarifier drive. On this day, the morning grab final effluent settleable solids was 10 ml/l. On the 15th, wiring was repaired on the flooded clarifier and the maintenance staff ordered a new motor. On the 16th, we obtained seed sludge from the Rockland, MA Wastewater Facility, the new clarifier drive motor was installed, and the activated sludge process was restored. Fecal coliform count on the 15th, was 31 colonies/100 ml.

From December 10th to the 15th (six days) our estimates of total pumpage, based on pump GPM and run times are:

Influent		36.9 MG
Effluent		36.2 MG
Portable Pumps	Approximately	1.0 MG

With 3 effluent pumps and 3 portable pumps running, sporadic topping of sidewalls was observed from the contact chamber. Also, spillage occurred from both primary clarifiers, but was kept to a minimum.

In reviewing this storm/flood, we estimated that the plant received influent sewage flows of greater than 13 MGD, possibly as high as 15 MGD (the existing flow metering system is only accurate up to 8 MGD). This high influent sewage flow was coupled with several outside plant ground floodings of up to 1.3 feet during several high tides over a 3-1/2 day period. Even under these extremely adverse conditions, all 4 plant influent and all 3 plant effluent pumps operated properly.

There were several problems encountered with hydraulic gates closing (normal automatic operation) due to high wet well levels and electrical outages caused by flooded electrical manholes. The hydraulic gates were never closed for more than about 15 minutes at any one time.

Since high influent sewage flows were higher than the capacity of the influent sewage pumps (>13 MGD), we were forced to throttle the influent gate to avoid flooding the plant and to maintain the influent wet well level in a range that would allow the influent pumps to operate. Because the maximum influent capacity of the plant was exceeded by the incoming flow, and because no additional by-pass system exists, the interceptor backed up.

This caused some residents basements to flood. The pump stations in the collection system continued to operate properly throughout the storm.

The sewage flows during this storm were by far the highest ever experienced in the seven years of M&E's operation. In the other storm events at the plant, there were several hours of storage in the interceptor and the influent pumps were able to process the flow without causing backups into homes along the interceptor.

STORM/FLOOD ISSUES

As reviewed earlier, several modifications to the plant were made in the early and mid 1980s to reduce the potentials for plant flooding and equipment damage. But, the December 1992 storm has shown that the existing systems, even though they worked properly, cannot handle a storm of significant magnitude without causing sewage backups. In addition, the existing systems were designed to handle peak flows with only 3 influent pumps (instead of 4) and 2 effluent pumps (instead of 3) so that backup pump units would be available if one pump failed.

The current system for processing sewage during a major storm is inadequate, both from a total capacity standpoint and lack of available back-up (i.e., firm capacity inadequate). Plant flow data for the past couple of years is shown in Appendix C.

Other issues related to the high flows are:

- Because the capacity of the influent pumps is greater than the capacity of the effluent pumps, some of the flow into the plant was by-passed (by overflowing the primary clarifier) during the storm.

- When the 3 permanent effluent pumps were pumping at full speed and the 3 portable pumps were pumping at full speed into the chlorine contact tank during high tide, the effluent outfall pipe from the chlorine contact tank could not handle all the flow and some of the flow overflowed the tank. Estimated peak effluent flow was >12.5 MGD.

- During the recent storm events of 1991 and 1992, the concrete walls and steel doors worked adequately to protect the plant buildings, except for the sludge blend box and gravity thickener system which were identified as requiring protection from outside flood waters. Piping modifications have recently been made to allow for emptying and isolating these tanks during floods.

OVERVIEW OF FACILITY OPERATIONS

The following is an overview of the facility operations, maintenance and storm/flood related issues. M&E has performed extensive changes to the facility operation and equipment since taking over operation in January 1988. Some of the highlights made to improve system reliability are as follows:

Personnel

- Provided extensive technical support personnel including O&M specialists, mechanical, electrical, and instrumentation support personnel, engineering support, legal support in addition to the regular plant staff. Most of this support is included as part of our normal contract operation of the plant, and some of this support work is performed through change orders. The emergency support during storms/floods has been extensive.

O&M

- Critical equipment is checked and exercised regularly, especially the hydraulic gates, which are exercised daily.

- All site personnel have pagers.

Plant Improvements

- Two dry pit effluent pumps have been replaced by submersible pumps.

- Installed new overhead electrical wiring/conduit to the effluent pumps.

- Removed old hydraulic drives on the effluent pumps as they failed and replaced them with VFDs, or eliminated them where appropriate.

- Performed extensive plant repairs, upgrades, and modifications as part of an ongoing aggressive equipment maintenance and capital improvement program.

CAUSE OF HIGH FLOWS/FLOODS

The cause of high flows into the facility are listed below:

- Heavy Rainfall
- I/I
- Homeowners sump pumps (estimated at 400)
- Residents opening manholes & clean-outs to empty flooded basements, yards, streets, etc.

The cause of flooding is flood tides.

The impact that the residents had on the high flow into the plant points out the need for better public education and communication in this area.

PROBLEMS ENCOUNTERED

The types of problems that arise from storms/floods includes:

- Building/equipment access – i.e., areas become inaccessible
- Power outages
- Process upsets
- Damage from sewer back-ups
- Electrical damage from flooding
- Mechanical damage from flooding
- Housekeeping – major cleanup
- Problems
- Personnel issues

HIGH FLOW OPERATIONS

We maintain two levels of response to high flows/plant flood events:

a) We use our Standard High Flow SOP for regular high flow events (See Appendix E).

Goal – maintain environmental standards by avoiding solids washout.

b) Our Emergency High Flow/Flood Procedures are still evolving. A copy of some of the forms we have used are included in Appendix F.

Goal – maintain public health & safety by keeping the interceptor from backing up.

Our reporting to the regulatory agencies basically addresses how well we managed one or both of the above procedures. Depending on what is going on, we call (and/or they call) the DEP and keep them informed of the situation as it is happening.

OTHER ISSUES

Several other issues arise from storm/flood events, especially when sewer system backups into resident's houses occur.

- Public health & welfare
- Newspaper/news media reports
- Law suits
- Damages
- Insurance issues
- Contractual and liability issues and "force majeure"
- Energy consumption costs
- Financial issues
- Reports, reports, reports

These issues are not discussed in any detail here, but they are mentioned because they may arise from storm/flood events.

RECOMMENDATIONS

Based on our experience with storm events and our knowledge of the treatment plant systems, we made the following recommendations in storm/flood report to the Hull Permanent Sewer Commission in March, 1993. The goal of the recommendations was to improve the plant and system operation during major storm events, especially the influent and effluent pumping systems. The current status of each of these recommendations is provided.

The influent and effluent pumping systems are critical to the Hull facilities for several reasons:

- There is no by-pass built into the collection system so all influent flow must be pumped at all times.
- The operation of the influent and effluent pumping system is crucial during storm/flood events.
- Influent and effluent pumping are major energy consumers at the facility.
- Proper speed control is required for both the influent and effluent pumps for efficient process control.

1. Increase the influent and effluent firm pumping capacities to 15 MGD, per the following:

   A. Increase the size and capacity of one of the smaller (20 HP) influent pumps to provide a pumping capacity of about 13.0 MGD with 3 pumps and about 14 MGD with 4 pumps. This is still being evaluated.

   B. Add piping to allow the existing 30 HP sludge transfer trash pump to pump influent during a storm (1.5 MGD). Also, add piping and a valve to interconnect the 8- and 16-inch influent pump force mains. The trash pump has been piped in; the interconnection of the force mains is still being evaluated.

C. Upgrade the two existing 50-HP effluent pumps to heavy duty sewage pumps with increased flow of about 5 MGD capacity each. This work is in process. One pump has been replaced with a 60-HP submersible pump, the other is being replaced with a new unit.

D. Add piping to allow the existing plant water system to tie into the effluent force main to add about 1.5 MGD of effluent pumping capacity. This is still being evaluated.

E. Add a fourth effluent pump of the same type and capacity as the existing submersible pump. This will allow for effluent pumping capacity equal to the influent pumping capacity. This is still being evaluated.

2. Upgrade Plant Control System:

A. Install 3 or 4 ultrasonic level measuring indicators in the interceptor to continuously provide data to a control panel at the sewage plant so that levels can be monitored and calibrated with system flows. One level indicator has been installed, but it's not yet operational.

B. Upgrade controls for plant hydraulic gate system to allow for central control panel operation. Upgrade influent gate hydraulic piston system to improve reliability. This is in the design/review stage.

C. Install clamp on flow meters on the two influent pump force mains to allow accurate measurement of incoming plant flows. The meters are on-site awaiting installation.

D. Update influent and effluent pump controls and provide for centralized monitoring and control of electrical motor loads, pumps, flows, wet well levels, and hydraulic gates. A main portion of a system wide SCADA system has been installed and the completion of the system is an ongoing process.

3. Purchase dual channel walkie-talkie/radio system for the plant with a channel to communicate with police/fire department to improve overall emergency communications.

4. Install automatically controlled gate operators on the aeration tank effluent gates which can be operated from the control panel. Listed as a future capital improvement.

5. Seal as many major building perimeter water leaks as possible, especially around electrical piping and wiring and repair electrical ground fault problems in MCCs

and other electrical systems that make the plant unsafe for plant workers during floods. Some of this work has been completed, but more needs to be done.

6. Update the effluent flow metering system to accurately measure flows up to 16 MGD – the current system is limited to 8 MGD.

7. Begin an annual I/I reduction program by providing $10,000-$20,000 per year for making collection system repairs over the next 10 years. This work is listed as future capital improvements.

8. Investigate the purchase a back-up portable 300 KW generator (or setup a contract agreement with one or two vendors to provide one during an emergency). This would be needed if Town power goes out and the existing plant generator malfunctioned. Several vendors have been contacted, but no formal contract has been written.

9. Install a connection to allow quick hook-up of this back-up generator.

10. Install a modification to eliminate the flooding potential of the thickeners from high flood tides. If the thickeners and blend box are shut down prior to a storm, than a shut off valve in the thickener overflow line is all that would be needed. Done.

11. By-pass some flow by pumping during a major storm to protect public health and safety. Currently, the primary clarifiers or aeration tanks will overflow and the chlorine contact tank will overflow during peak flows. Review this with DEP/EPA. This requires a detailed engineering review.

12. Investigate the raising of the existing incoming electrical power transformer and re-routing the electrical lines above ground and into the control building overhead. This is still being evaluated.

13. Investigate building a berm around the entire plant site at the 100 year storm level. This requires an engineering review.

14. Investigate the current physical condition and hydraulic capacity of the existing outfall pipe and the applicability of installing an additional outfall pipe to meet the peak hydraulic flow of 15 MGD. This requires an engineering review.

15. Install permanent slide rails for panels to be installed at all plant storm doors/openings to raise the level above the four foot level to the 100 year storm level (i.e., raise height of storm doors and walls to a higher level). The peak storm ocean level/wave surge needs to be studied as part of an engineering review for the 100/500 year storm. The rising sea level affects due to global warming need to be factored into this review.

16. Purchase a portable back-up generator for the pump stations. Done.

17. Cut trough drains in the garage floor to channel water that seeps through during a storm to flow directly into the garage drain. Needs to be reviewed.

18. Interconnect the influent and effluent wet wells and add a back up 50-HP or 60-HP pump that could be used for either influent pumping or effluent pumping. This recommendation is being evaluated at this time.

FUTURE NEEDS/FUTURE PLANS

Planning for future high flow/flood events will include many items. Several of the recommendations mentioned earlier require engineering review/study. Some critical areas to be studied include:

- Impact of 100 and 500 year storm tides on the facility (and the Town as well)
- Plant pumping capacities and by-pass capabilities
- Impact of global warming on ocean levels at Hull

Other activities planned include ongoing training for storms/floods. The treatment plant Manager and Assistant Manager will be attending a week long training session along with the Town of Hull emergency response committee this March. This training is given by FEMA and covers emergency training/planning for hurricanes.

Improvements and modifications to plant equipment have been extensive during the past several years, and there are many more ongoing and planned improvements and modifications especially focusing on I/I improvements in the collection system. Improving the overall reliability and capacity of the systems at the facility is the main goal. Providing a well-maintained and cost-effective sewage system is the long-term goal. Providing public education and communication is a necessary aspect for long-term success dealing with storms/floods.

APPENDIX A

EXCERPTS FROM 1993 BLACK & VEATCH REPORT

II. EFFLUENT PUMPING STATION

A. GENERAL DESCRIPTION

The Effluent Pumping Station receives flow from the two secondary clarifiers and lifts the wastewater to the chlorination tank. From this tank, the wastewater flows by gravity through an outfall into the ocean.

The pumping station is a contiguous part of the Control Building, with the pump room floor located about 19 feet below finish grade. The wet well is located directly beneath the pump room. Flow from the secondary clarifiers enters the wet pit at three

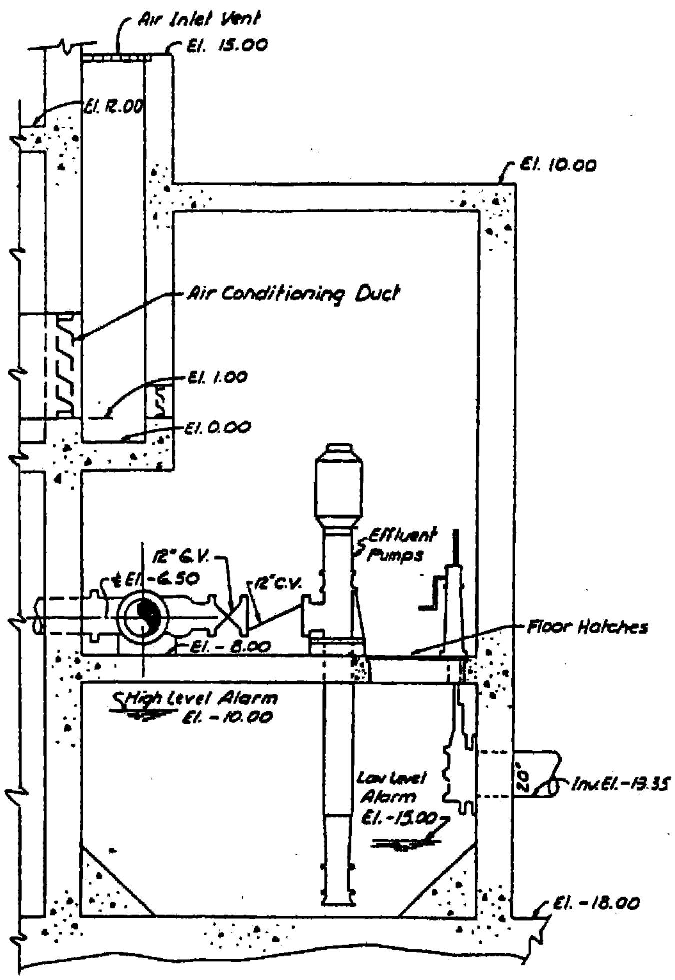

Figure 15. HULL, MASSACHUSETTS
EFFLUENT PUMPING STATION, 1983

Table 17. EFFLUENT PUMPING STATION CRITICAL ELEVATIONS

Elevation	Remarks	Response time (Minutes)	
		1 mgd	*3 mgd*
+12.0	Pump Room entrance floor	-	-
+10.0	Ceiling of Pump Room	150	50
+1.0	Bottom of ventilation ducts	82.5	27.5
0.0	Top of pump motors	75	25
-3.0	Bottom of pump motors	52.5	17.5
-6.0	Pump electrical control box & bottom of variable drive unit	30	10
-8.0	Pump room floor	15	5
-10.0	High water level alarm	-	-
-13.0	Lead pump start	-	-
-15.0	Low water level alarm	-	-
-18.0	Wet well floor	-	-

points. A manually operated sluice gate is provided at each inlet and is equipped with a crank operator floor stand. The station is equipped with three 2700 gpm variable speed electric motor driven vertical propeller pumping units. The pumps discharge into a common pipe header within the pump room. The header continues through the pump room wall into the basement area, then underground to the chlorination tank.

Three hatches are provided in the pump room floor for access down into the wet pit.

B. FLOODING POTENTIAL

Although the pump room is laid out to function as a dry pit, it is subject to complete flooding by wastewater rising through the floor hatches from the wet pit below should the pumping units malfunction. Such malfunctions and partial flooding have occurred on several occasions, and only quick action by plant operating personnel prevented disabling pump room flooding. Past malfunctions have occurred at low plant flows. Had the flows been slightly higher, it is questionable that operating personnel would have had sufficient response time to prevent disabling flooding. Figure 15 presents a cross-section of the Effluent Pumping Station illustrating critical elevations as presented in Table 17.

The Response Time column shows the amount of time the plant operating personnel would have, in the event of station malfunction, from the moment that the High Water Level Alarm sounds, until the water level would reach the particular elevation. At a flow rate of 1.0 mgd, the rise rate would be approximately 7.5 minutes per foot; at 3.0 mgd, the rise rate would be about 2.5 minutes per foot. It is seen that the pump room floor could become flooded within a period of 5 to 15 minutes under the current plant flow range of 1 to 3 mgd.

IV. GENERAL PLANT

A. ARRANGEMENT OF FACILITIES

The WWTP is located near the north end of Hull and is bounded on two sides by water. There is no residential development immediately adjacent to the plant and the plant site contains approximately 4 acres that is secured by a 6-foot high chain link fence. Entry to the plant may be gained either from Nantasket Avenue or from Spring Street.

The largest aboveground structure on the site is the Control Building. This structure is approximately 129 feet long by 49 feet wide and contains two levels below ground, one at ground level, and a second story. Most of the personnel-related activities are performed in this structure. In addition to housing facilities for pretreatment of influent wastewater and solids processing, the building is equipped with a conference room, records room, maintenance shop, three restrooms (one with locker and shower facilities), an office, plan room, lunch room, and a full-scale laboratory.

Other major structures on the plant site include two primary clarifiers with an underground sludge pumping station, four aeration tanks, two secondary clarifiers with an underground sludge pumping station, a chlorine contact tank, two covered gravity sludge thickener basins, two belowground sludge holding tanks, and a below-ground septic sewage holding tank.

Raw wastewater from the sewage collection system enters the Control Building at a level about 17 feet below ground level where it is processed through the pretreatment facilities prior to being pumped to the primary clarifiers. The waste-water flows by gravity through the aeration tanks and secondary clarifiers to the effluent pumping station wetwell where it is then pumped to the chlorine contact tank and then flows by gravity to the Atlantic Ocean.

Although less land area was required to locate all of the pretreatment process facilities ahead of initial pumping, the arrangement does not lend itself to be the most advantageous from the standpoint of operating convenience. In a more conventional arrangement, the coarse bar screen and influent pumping facilities would have been located below grade with the Parshall flume, comminutor and aerated grit chamber located above ground level. With the present arrangement, not only is access to these facilities made less convenient, but grit and screenings handling is made more difficult.

One problem already realized in the plant's history is the susceptibility of the Control Building to flooding. The current practice of locating major electrical devices, such as motor control centers, above a potential flood elevation or high water level was not followed. In general, each motor control center has been located adjacent to the equipment it serves, regardless of whether that equipment is installed on the subbasement floor level, basement floor level, or above grade.

The present arrangement of facilities within the Control Building and the layout of the structure expose the building to flooding from three sources:

1. Headworks:

If the influent sewage pumps were to become inoperable and remain inoperable for an extended period of time, the entire headworks area could be flooded with raw wastewater since there presently exists no positive means of plant overflow or bypass.

To delay flooding of the headworks area, plant operating personnel have installed stop plate grooves in the influent channel preceding the coarse bar rack. Installation of the stop plate during times when the influent flow exceeds operable pump capacity might be effective in stopping the flow for a time, but it would be inadequate over an extended period of time because the plate would be overtopped. The need for an emergency plant bypass is further discussed in Section C.

2. Effluent Pumping Station:

Similarly, if the effluent sewage pumps become inoperable, as has occurred on several occasions, the pump room can be flooded since the wet pit is located below the pump room floor and water can rise through floor hatches into the pump room. Although sluice gates are provided at the wetwell influent, the gate operators are located within the pump room and could become inaccessible due to the flooding. Closure of these gates would cause flooding or overflow of upstream facilities.

3. Outside Flooding:

Furthermore, entrance of outside flood water into the building through the ground level ventilation grates and doorways proved to be a problem during the blizzard in 1978. During the blizzard in 1978, flood water from the Atlantic Ocean inundated the plant site. Flood waters reached a level of about 1.5 feet above the ground level operating floor. Construction of the plant was nearing completion at the time and extensive damage was reported. As a means of protecting the Control Building from flooding in the future, concrete walls were constructed in front of each ventilation grate and gasketed steel doors were placed in front of all building entrances. With construction of the concrete walls and gasketed steel doors, the potential for damage to the Control Building from outside flood waters has been reduced. However, there remains no positive means of protecting belowground equipment from damage due to excessive wastewater flow.

B. HYDRAULIC CONSIDERATIONS

An indication of expected water surface elevations at the design average flow of 3.07 mgd and peak flow of 7.80 mgd was included in the design drawings and designated as "HYDRAULIC PROFILE". A review was made of this drawing to determine accuracy of the information presented on the drawing, to determine the maximum hydraulic capacity of the plant at different ocean levels, and to determine the feasibility of bypassing the effluent pumping station and discharging the plant effluent by gravity.

Although numerous differences in water surface elevations were encountered between the values shown on the drawing and the values calculated as part of this review, none of the differences are considered to be of a magnitude to cause concern. The water surface elevations shown on the drawing are considered to be within the range of accuracy expected in such calculations and are felt to be representative of actual conditions.

To determine maximum hydraulic capacity of the plant, separate analyses were performed using the maximum high water level (El. +10.0) in the ocean and mean high water level (El. +4.50) in the ocean. In both analyses, a maximum submergence of the chlorine contact effluent weirs of 60 percent was allowed. At maximum high water level in the ocean, the maximum hydraulic capacity of the plant was determined to be about 7.6 mgd, significantly below the Ultimate Peak Daily Flow of 10.0 mgd. At mean high water level in the ocean, the maximum hydraulic capacity of the plant was determined to be about 11.6 mgd. With a plant flow of 11.6 mgd, however, the secondary clarifier effluent weirs would be submerged.

Each of the analyses are based on the assumption that the invert of influent and effluent pipes at SMH No. S-2 is El. -0.45 as shown on the "HYDRAULIC PROFILE" drawing and not at the level (Inv. El. +0.38) indicated on the plan sheet showing construction details for this structure. If the invert level of these pipes is at El. +0.38, 11.6 mgd could still be processed through the plant, but the submergence over the chlorine contact effluent weirs would be in excess of 60 percent. Under this condition, the secondary clarifier effluent weir would be submerged even greater than before. The clarifier walkway and drive unit would remain above the high water level, however.

As part of the hydraulic analysis of the plant, the feasibility of bypassing the Effluent Pumping Station and discharging directly to the ocean by gravity was investigated. Due to the fact that the weir in each secondary clarifier is at a much lower elevation than is the effluent weir in the chlorine contact tank, a strict gravity discharge would result in not only bypassing the Effluent Pumping Station, but also would result in bypassing the chlorine contact tank, as well. As regulations require chlorination at all times and that means of sampling the chlorinated effluent be provided, a new chlorine contact tank constructed at a lower elevation would be required. The cost of such new facilities would outweigh the savings of lower pumping costs.

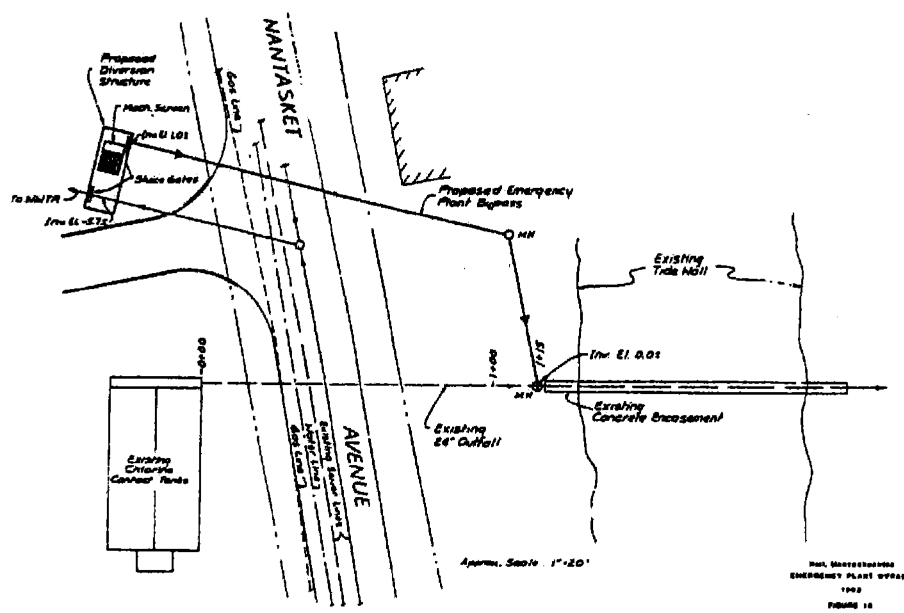

Figure 16. HULL, MASSACHUSETTS
EMERGENCY PLANT BYPASS, 1983

C. EMERGENCY PLANT BYPASS

As discussed in Section IV A above, the plant headworks is exposed to potential flooding due to a lack of positive means of plant overflow or bypass. Such flooding of a key facility would render the entire plant inoperable for an extended period of time and cause incalculable damage to the plant itself as well as to residential and commercial structures within the collection system and to the environment. Although an emergency bypass may temporarily degrade the ocean environment, and may at extreme high tides, cause basement flooding in the collection system, it is clear that the lack of an emergency bypass poses a much greater threat. Therefore, it is recommended that an emergency plant bypass be constructed on the plant site in the general arrangement shown on Figure 16. Field surveys should be conducted to verify critical pipe elevations and assure the viability of the general arrangement.

The emergency bypass would consist of a new diversion structure containing sluice gates and a mechanical screen, bypass piping, and manhole structures as shown.

The opinion of probable cost for the emergency bypass facilities is $210,000, including contingencies, engineering and administrative costs.

APPENDIX B

Hydraulic Gate System Design

The Hull facility is equipped with a hydraulic gate system which protects the pump rooms from flooding, by operating sluice gates in the influent and effluent wet wells. One is located at the influent channel and the remaining 3 are located at the effluent wet wells. From the interceptor sewage flows by gravity into the headworks area where the influent gate is located. Should the influent wet well level rise to greater than 90 inches, the influent gate will shut automatically. Should a high effluent wet well condition arise, all 3 effluent gates will shut automatically. As all 4 gates are interlocked electrically, the closure of any gate automatically closes all the gates. Following a gate closure event, operators must allow the wet wells to drop below alarm levels and then manually re-open each of the hydraulic gates.

Facility influent pumping capacity exceeds effluent capacity by approximately 2 MGD. During periods of high flow this difference in capacity creates the potential for flooding the effluent pump room wet wells.

If the water level in the influent or effluent wet wells exceeds a given point, the gates automatically close. To counter act repeated gate closures during flood events, operators at the facility must manually operate the gates in order to avoid flooding areas of the plant. To mitigate the effluent pump system capacity deficit, portable pumps have been used to help the effluent pumps move water from the secondary clarifiers to the chlorine tank. Without the hydraulic gate system one or more of the following would occur.

- Excessive influent wet well levels would back up the water level in the interceptor and the headworks area. The water would rise until it flooded the entire headworks area, flooding out the sub-basement level grit pump room and eventually flowing out the entrance door to headworks and into the yard. Simultaneously, flooding of basements connected to the interceptor would occur.

- Without effluent wet well gates, during flood events, this room would flood causing electrical damage and failure of the two standard effluent pumps. With no effluent pumping, the secondary clarifiers would backup, flooding out clarifier drive motors, and there would be no treatment until the use of secondary drive motors and effluent pumps was re-established.

APPENDIX C

HULL WPCF FLOW DATA

MONTH	YEAR	AVG. DAILY FLOW	MONTHLY AVG. MAXIMUM FLOW	MONTHLY AVG. MINIMUM FLOW	MAXIMUM HOURLY FLOW MONTHLY	MAXIMUM DAILY FLOW MONTHLY	MINIMUM HOURLY FLOW MONTHLY	MINIMUM DAILY FLOW MONTHLY
JAN	1991	1.42	2.01	0.73	5.05	3.20	0.30	0.80
FEB	1991	1.28	1.63	0.68	2.00	1.72	0.40	1.10
MAR	1991	1.75	2.28	1.20	4.70	3.00	0.70	1.20
APR	1991	1.62	2.22	1.03	7.35	4.77	0.50	1.10
MAY	1991	1.42	2.07	1.17	2.75	1.97	0.70	0.80
JUNE	1991	1.41	2.20	1.20	4.30	1.73	0.50	0.90
JULY	1991	1.53	2.33	1.35	3.20	2.70	0.90	1.10
AUG	1991	1.63	2.57	1.33	6.30	2.20	1.00	1.20
SEPT	1991	1.75	2.77	1.53	6.15	3.43	1.00	1.20
OCT	1991	1.70	3.20	1.60	10.00	5.50	0.70	1.00
NOV	1991	2.12	3.25	1.67	10.10	10.00	1.00	1.70
DEC	1991	1.70	2.20	0.80	3.80	1.70	0.80	0.60
AVERAGE	1991	1.61	2.39	1.60	5.48	3.49	0.71	1.06
MAX/MIN	1991		3.25	0.68	10.10	10.00	1.00	0.60
JAN	1992	1.70	2.40	1.60	4.00	3.00	0.90	1.30
FEB	1992	1.50	2.10	1.20	3.00	1.90	0.60	1.00
MAR	1992	1.50	2.30	0.90	3.40	1.90	0.20	1.00
APR	1992	1.70	2.30	1.20	3.40	2.50	0.80	1.30
MAY	1992	1.50	2.10	1.40	5.00	2.00	0.50	1.10
JUNE	1992	1.60	2.20	1.80	4.50	2.30	0.40	1.00
JULY	1992	1.64	2.10	1.60	2.60	2.40	0.50	1.20
AUG	1992	1.76	2.40	1.70	6.10	2.50	0.50	1.20
SEPT	1992	1.45	2.10	1.50	3.10	2.40	0.50	1.00
OCT	1992	1.32	2.00	1.70	3.10	1.90	0.70	0.90
NOV	1992	1.46	2.20	1.70	3.30	2.40	0.50	1.20
DEC	1992	2.40	3.50	1.80	12.50	12.20	0.70	1.30
AVERAGE	1992	1.63	2.31	1.51	4.50	3.12	0.57	1.12
MAX/MIN	1992		3.50	0.90	12.50	12.20	0.20	0.90
JAN	1993	1.67	2.30	1.10	3.60	1.60	0.60	1.30
FEB	1993	2.01	2.90	1.40	6.30	1.60	0.90	1.40
MAR	1993	1.50	2.30	0.90	3.40	1.90	0.20	1.00
APR	1993	2.50	3.70	1.80	7.20	5.00	1.20	1.30
MAY	1993	1.54	2.30	1.00	3.20	2.00	0.70	1.10
JUNE	1993	1.28	2.30	0.90	2.90	1.70	0.40	0.70
JULY	1993	1.56	2.33	1.04	2.80	1.98	0.20	1.03
AUG	1993	1.64	2.45	1.08	4.70	2.41	0.70	1.23
SEPT	1993	1.62	2.60	1.25	5.00	2.10	0.90	1.12
OCT	1993	1.35	2.52	1.04	3.20	2.00	0.70	0.88
NOV	1993	1.48	2.32	1.04	3.20	2.08	0.60	1.10
DEC	1993	2.40	3.46	1.96	8.50	4.18	1.10	1.55
AVERAGE	1993	1.71	2.62	1.21	4.33	2.38	0.68	1.14
MAX/MIN	1993		3.70	0.90	7.20	5.00	0.20	0.70
JAN	1994	1.95	2.82	1.43	6.30	2.56	0.80	1.30
FEB	1994	1.84	2.49	1.37	4.10	2.85	0.90	1.34
MAR	1994	2.85	3.63	2.29	7.30	5.56	1.40	1.66
APR	1994	1.67	2.25	1.28	3.10	2.18	0.80	1.32
MAY	1994	1.76	2.47	1.38	3.00	2.34	0.80	1.37
JUNE	1994	1.53	2.13	1.14	3.00	2.24	0.80	1.02
JULY	1994	1.72	1.97	1.30	3.50	1.97	0.80	1.30
AUG	1994	2.03	2.59	1.31	5.00	3.22	0.70	1.50
SEPT	1994	1.80	2.37	1.26	3.50	2.44	1.00	1.48
OCT	1994	1.63	2.14	1.06	3.20	2.17	0.70	1.40
NOV	1994	1.65	2.24	1.07	3.20	2.40	0.70	1.23
DEC	1994	2.12	3.12	1.52	7.40	5.30	0.70	1.38
AVERAGE	1994	1.88	2.52	1.37	4.38	2.94	0.84	1.38
MAX/MIN	1994		3.63	1.06	7.40	5.56	0.70	1.02

APPENDIX C

HULL WPCF FLOW DATA

MONTH	YEAR	AVG. DAILY FLOW	MONTHLY AVG. MAXIMUM FLOW	MONTHLY AVG. MINIMUM FLOW	MAXIMUM HOURLY FLOW MONTHLY	MAXIMUM DAILY FLOW MONTHLY	MINIMUM HOURLY FLOW MONTHLY	MINIMUM DAILY FLOW MONTHLY
JAN	1991	1.42	2.01	0.73	5.05	3.20	0.30	0.80
FEB	1991	1.28	1.63	0.68	2.00	1.72	0.40	1.10
MAR	1991	1.75	2.28	1.20	4.70	3.00	0.70	1.20
APR	1991	1.62	2.22	1.03	7.35	4.77	0.50	1.10
MAY	1991	1.42	2.07	1.17	2.75	1.97	0.70	0.80
JUNE	1991	1.41	2.20	1.20	4.30	1.73	0.50	0.90
JULY	1991	1.53	2.33	1.35	3.20	2.70	0.90	1.10
AUG	1991	1.63	2.57	1.33	6.30	2.20	1.00	1.20
SEPT	1991	1.75	2.77	1.53	6.15	3.43	1.00	1.20
OCT	1991	1.70	3.20	1.80	10.00	5.50	0.70	1.00
NOV	1991	2.12	3.25	1.67	10.10	10.00	1.00	1.70
DEC	1991	1.70	2.20	0.80	3.80	1.70	0.80	0.60
AVERAGE	1991	1.61	2.39	1.60	5.46	3.49	0.71	1.06
MAX/MIN	1991		3.25	0.68	10.10	10.00	1.00	0.60
JAN	1992	1.70	2.40	1.60	4.00	3.00	0.90	1.30
FEB	1992	1.50	2.10	1.20	3.00	1.90	0.60	1.00
MAR	1992	1.50	2.30	0.90	3.40	1.90	0.20	1.00
APR	1992	1.70	2.30	1.20	3.40	2.50	0.80	1.30
MAY	1992	1.50	2.10	1.40	5.00	2.00	0.50	1.10
JUNE	1992	1.60	2.20	1.80	4.50	2.30	0.40	1.00
JULY	1992	1.64	2.10	1.60	2.60	2.40	0.50	1.20
AUG	1992	1.76	2.40	1.70	6.10	2.50	0.50	1.20
SEPT	1992	1.45	2.10	1.50	3.10	2.40	0.50	1.00
OCT	1992	1.32	2.00	1.70	3.10	1.90	0.70	0.90
NOV	1992	1.46	2.20	1.70	3.30	2.40	0.50	1.20
DEC	1992	2.40	3.50	1.80	12.50	12.20	0.70	1.30
AVERAGE	1992	1.63	2.31	1.51	4.50	3.12	0.57	1.12
MAX/MIN	1992		3.50	0.90	12.50	12.20	0.20	0.90
JAN	1993	1.67	2.30	1.10	3.60	1.60	0.60	1.30
FEB	1993	2.01	2.90	1.40	6.30	1.60	0.90	1.40
MAR	1993	1.50	2.30	0.90	3.40	1.90	0.20	1.00
APR	1993	2.50	3.70	1.80	7.20	5.00	1.20	1.30
MAY	1993	1.54	2.30	1.00	3.20	2.00	0.70	1.10
JUNE	1993	1.28	2.30	0.90	2.90	1.70	0.40	0.70
JULY	1993	1.56	2.33	1.04	2.80	1.96	0.20	1.03
AUG	1993	1.64	2.45	1.08	4.70	2.41	0.70	1.23
SEPT	1993	1.62	2.60	1.25	5.00	2.10	0.90	1.12
OCT	1993	1.35	2.52	1.04	3.20	2.00	0.70	0.88
NOV	1993	1.48	2.32	1.04	3.20	2.06	0.60	1.10
DEC	1993	2.40	3.46	1.96	6.50	4.18	1.10	1.55
AVERAGE	1993	1.71	2.62	1.21	4.33	2.38	0.68	1.14
MAX/MIN	1993		3.70	0.90	7.20	5.00	0.20	0.70
JAN	1994	1.95	2.82	1.43	6.30	2.56	0.80	1.30
FEB	1994	1.84	2.49	1.37	4.10	2.85	0.90	1.34
MAR	1994	2.85	3.63	2.29	7.30	5.56	1.40	1.66
APR	1994	1.67	2.25	1.28	3.10	2.18	0.80	1.32
MAY	1994	1.78	2.47	1.38	3.00	2.34	0.80	1.37
JUNE	1994	1.53	2.13	1.14	3.00	2.24	0.80	1.02
JULY	1994	1.72	1.97	1.30	3.50	1.97	0.80	1.30
AUG	1994	2.03	2.59	1.31	5.00	3.22	0.70	1.50
SEPT	1994	1.80	2.37	1.26	3.50	2.44	1.00	1.48
OCT	1994	1.63	2.14	1.06	3.20	2.17	0.70	1.40
NOV	1994	1.65	2.24	1.07	3.20	2.40	0.70	1.23
DEC	1994	2.12	3.12	1.52	7.40	5.30	0.70	1.38
AVERAGE	1994	1.86	2.52	1.37	4.36	2.84	0.84	1.36
MAX/MIN	1994		3.63	1.06	7.40	5.50	0.70	1.02

METCALF & EDDY SERVICES, HULL WPCF
HIGH FLOW SOP/FLOW DIVERSION

Goal:

The goal of flow diversion is to change the process from conventional to contact stabilization in order to reduce the solids loading on the secondary clarifiers and minimize solids loss. High flow at the Hull WWTF will be defined as greater than 3.07 MGD.

It is necessary to divert flow when:

A. Total plant effluent flow exceeds 3.07 MGD, combined with consistent solids washout from one or both of the secondary clarifiers.

B. The forecast is for continued rain, and plant flows are expected to continue at greater than design flow for a period of at least six (6) hours.

Note: In case of billowing solids or momentary solids loss, it is not necessary to divert flow through the plant.

The steps to be taken for high flow diversion are as follows:

A. Check to ensure drain line to aeration tank to be filled is closed.

B. Open influent gate to the aeration tank to be filled. The diversion should be partial to avoid shutting down the plant water system and creating a surge to the effluent wet wells when the diversion is complete.

Note: If aeration tank #2 is on line then #4 should be used for diversion in order to set-up contact stabilization using the cross-connect valve. The same applies for tanks #1 & #3.

C. Once you have filled your contact tank (aeration tk) #4 or #3, you should close off the influent to the stabilization tank (#1 or #2) and again open the cross connect valve.

D. The return rate should be at its maximum and feeding your stabilization tank.

Note: You should adjust the valves at the end of the aeration tank as needed to avoid back filling the empty aeration tanks.

Collection Systems Profile Highlight

Home:	*Hull, Massachusetts*
Age of System:	*Some sewers documented to 1860s. Most installed in late 1970s/early 1980s.*
Service Population:	*Year round population-10,000; seasonal population-33,000.*
Treatment Facility:	*Design flow 3.07 mgd secondary treatment using conventional activated sludge process.*
Collection System:	*Four miles of 30- and 36-in reinforced concrete interceptor pipe. Approximately 40 miles of collector sewers. The collection system connects approximately 4,000 residential and business units to the treatment facility and has just about every type of pipe ever made including oval brick; vitrified clay; asbestos cement; PVC; ductile iron; and who knows what else!*
Pumping Stations:	*Seven pumping stations ranging in size from 150 gpm to 1,700 gpm with a total length of force mains of approximately 14,000 feet. Six stations have emergency backup power and all stations have isolation valves to bypass the pump station and pump directly from the wet well to the force main using portable trash pumps.*
O&M Program:	*As part of an operation and maintenance service agreement with the town which includes the treatment facility and collection system, Metcalf & Eddy operates the collection system and performs routine cleaning, maintenance, and emergency response/repair. Routine inspections and cleaning are performed in three phases: 1) annual inspection and necessary flushing of problem areas reported in the Sewer System Evaluation Survey Report as well as problem areas encountered during day-to-day operations; 2) tri-annual inspection and necessary flushing of collection system constructions prior to 1970; and 3) inspection and necessary flushing of all other collection system areas every 5 years. The goals of this preventive maintenance program are to reduce the number of blockage calls; minimize the potential for backup which can cause basement flooding and manhole overflows; and increase line capacity by removing sand, silt and debris.*
Safety Program:	*A collection system health and safety manual and procedures with a manhole entry permit system has been in place since 1990.*
Unique Aspects:	*A four barrel siphon consisting of 1-10", 2-16", and 1-18", 60 feet long was constructed along the interceptor to allow for placement of a 48" drainage culvert under the 36" interceptor. Hull is a seacoast community consisting of a narrow peninsula surrounded by water, located on the south side of Boston, and is vulnerable to northeast storms such as occurred during the Blizzard of 1978. Since most of the collection system is located in lowlands which are subject to flooding, watertight manhole covers are used to minimize inflow potential from storm flooding. A storm preparedness emergency plan is a key element of the collection and treatment systems.*

Collection Systems Profile

The Collection Systems Committee has developed a questionnaire that municipal and private treatment plant administrators, operators, and consultants are being asked to complete. The information will be made available to all NEWEA members, profiles will be compiled into a reference manual, and the committee hopes to publish a plant profile in NEWEA News on a regular basis. For more information, contact chair John Struzziery at 617-498-4685.

NEWEA Recognizes...

Congratulations to past president **Norman Cherubino,** who received the Ken O. Hodgdon Award from the New England Water Works Association.

For those of you who haven't caught up with one woman's whirlwind life, **Lorraine Sander** is:

A. The new Public Works Director for the City of Nashua, New Hampshire.

B. On WEF President Mike Pollen's Executive Committee.

C. The Zone 1 PWOD Representative (and automatically a Federation Director).

D. All of the above.

Congratulations, Lorraine!

Best wishes to **Rick Seymour** who is the new Superintendent at the Nashua WWTF.

METCALF & EDDY SERVICES, HULL WPCF
HIGH FLOW SOP/FLOW DIVERSION

GOAL: THE GOAL OF FLOW DIVERSION IS TO CHANGE THE PROCESS FROM CONVENTIONAL TO CONTACT STABILIZATION IN ORDER TO REDUCE THE SOLIDS LOADING ON THE SECONDARY CLARIFIERS AND MINIMIZE SOLIDS LOSS. HIGH FLOW AT THE HULL WWTF WILL BE DEFINED AS GREATER THAN 3.07 MGD.

IT IS NECESSARY TO DIVERT FLOW WHEN:

A. TOTAL PLANT EFFLUENT FLOW EXCEEDS 3.07 MGD, COMBINED WITH CONSISTANT SOLIDS WASHOUT FROM ONE OR BOTH OF THE SECONDARY CLARIFIERS.

B. THE FORECAST IS FOR CONTINUED RAIN, AND PLANT FLOWS ARE EXPECTED TO CONTINUE AT GREATER THAN DESIGN FLOW FOR A PERIOD OF AT LEAST SIX (6) HOURS.

NOTE: IN CASE OF BILLOWING SOLIDS OR MOMENTARY SOLIDS LOSS, IT IS NOT NECESSARY TO DIVERT FLOW THROUGH THE PLANT.

THE STEPS TO BE TAKEN FOR HIGH FLOW DIVERSION IS AS FOLLOWS:

A. CHECK TO ENSURE DRAIN LINE TO AERATION TANK TO BE FILLED IS CLOSED.

B. OPEN INFLUENT GATE TO THE AERATION TANK TO BE FILLED. THE DIVERSION SHOULD BE PARTIAL TO AVOID SHUTTING DOWN THE PLANT WATER SYSTEM AND CREATING A SURGE TO THE EFFLUENT WET WELLS WHEN THE DIVERSION IS COMPLETE. (NOTE: IF AERATION TANK #2 IS ON LINE THEN #4 SHOULD BE USED FOR DIVERSION IN ORDER TO SET-UP CONTACT STABILIZATION USING THE CROSS - CONNECT VALVE. THE SAME APPLIES FOR TANKS #1 & #3.

C. ONCE YOU HAVE FILLED YOUR CONTACT TANK (AERATION TK) #4 OR #3 YOU SHOULD CLOSE OFF THE INFLUENT TO THE STABILIZATION TANK (#1 OR #2) AND AGAIN OPEN THE CROSS CONNECT VALVE.

D. THE RETURN RATE SHOULD BE AT ITS MAXIMUM AND FEEDING YOUR STABILIZATION TANK.

NOTE: YOU SHOULD ADJUST THE VALVES AT THE END OF THE AERATION TANK AS NEEDED TO AVOID BACK FILLING THE EMPTY AERATION TANKS.

REVISED 1/23/95 FILENAME; "FLOWSOP.DOC"